The focus of active remediation would be on preventing contaminated ground water from reaching potentially sensitive surface water areas, as opposed to accelerating the removal of contaminants from the aquifer, although it is anticipated that remediation should enhance the cleanup process. The proposed action would intercept ground water before it entered the surface water, thereby providing plume containment and contaminant mass reduction. In addition, injection and/or application of freshwater collected from the Colorado River upstream from the Moab site and pumped from the Moab site water storage ponds may provide a continuous source of uncontaminated water to the margins of the river where contaminant exposure could be the greatest.

DOE also analyzes the No Action alternative (Section 2.4), which serves as a baseline for comparing all alternatives, as required by NEPA regulation. Section 2.5 discusses alternatives that were considered but dismissed from detailed discussion in the EIS. Section 2.6 compares the impacts that would result among the five alternatives, including the No Action alternative. Other decision-making factors, such as costs and comments received from NAS, are discussed in Section 2.7.

2.1 On-Site Disposal Alternative

Figure 2–3 illustrates the major Moab site features and approximate locations of temporary on-site areas and facilities that would be utilized under the on-site disposal alternative.

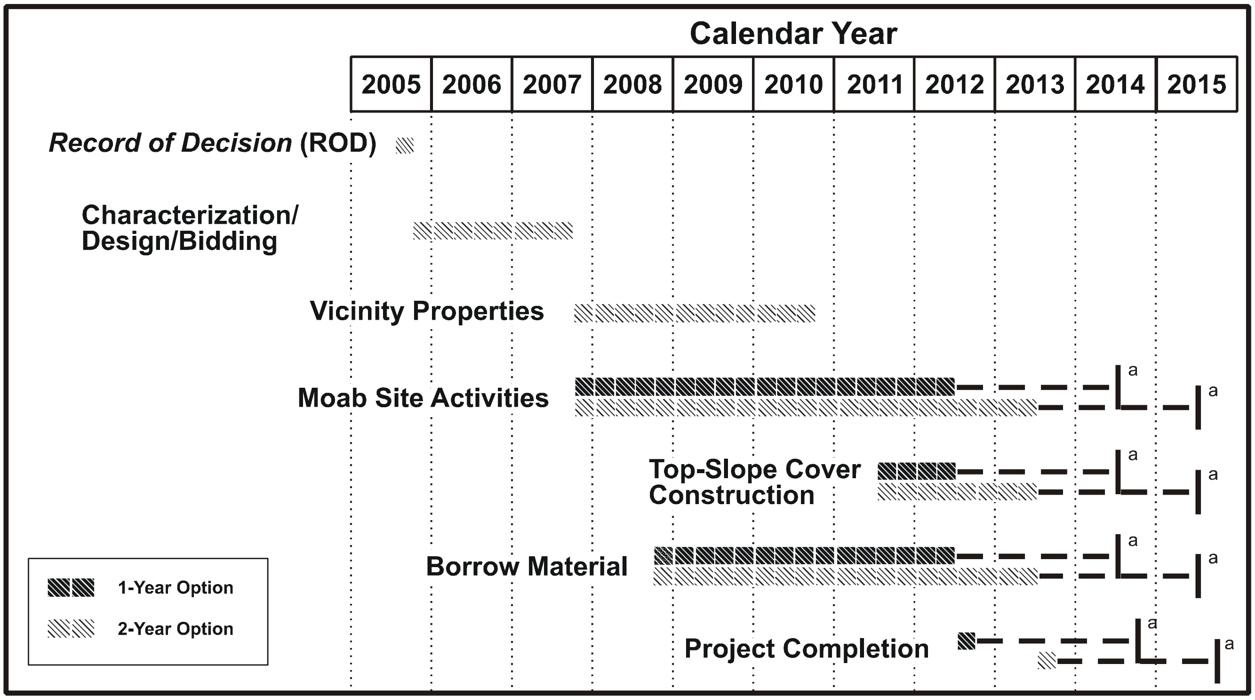
The major activities that would occur if the on-site disposal alternative were implemented would be

- Construction and operations at the Moab site (Section 2.1.1).
- Characterization and remediation of vicinity properties and disposal of contaminated materials at the Moab site (Section 2.1.2).
- Construction and operations at the borrow areas (Section 2.1.3).
- Monitoring and maintenance at the Moab site after site remediation was complete (Section 2.1.4).
- Ground water remediation at the Moab site (Section 2.3).

Resource requirements for remediation activities are discussed in Sections 2.1.5 and 2.2.7.

For the on-site disposal alternative, DOE assumed one work shift schedule for site and vicinity property remediation; that is, a single 12-hour work shift from 7:00 a.m. to 7:30 p.m., 7 days per week, 50 weeks per year. Only one work shift schedule was considered because the controlling factor determining how quickly work could progress for the on-site disposal alternative would be the rate at which the tailings pile consolidated or settled after excavated site soil and vicinity property material were placed on top of the pile. It could take 3 to 5 years for the pile to settle sufficiently to allow cap construction to begin. This consolidation process is discussed further in Section 2.1.1.2. A double work schedule for excavating soil and loading contaminated materials on the pile would not offer advantages in terms of project completion because of the need to wait for sufficient pile settling. However, to allow some flexibility in targeting a project completion date, DOE did consider a 2-year and a more aggressive 1-year time frame for completing construction of the top slope cover once settling was sufficiently under way. Both top slope cover construction schedules would employ a single work shift; the difference would be in the number of workers.

DOE estimates that all surface remediation activities under the on-site disposal alternative would be completed 7 to 8 years from the issuance of a ROD, depending on whether the 2-year or 1-year top slope cover construction schedule were implemented (Figure 2–4). However, as indicated in the figure, the schedule allows for a possible extension of approximately 2 years because of the 2-year uncertainty associated with the amount of time it would take for the tailings pile to consolidate.



[a]Uncertainty related to pile consolidation (see Section 2.1.1.2).

Figure 2–4. On-Site Disposal Alternative Surface Remediation Activity Schedule

2.1.1 Construction and Operations at the Moab Site

For the purpose of describing the on-site alternative activities, this section addresses four elements: (1) site preparation, infrastructure enhancement, and controls; (2) contaminated material remediation operations; (3) disposal cell recontouring, slope stabilization, and capping; and (4) site reclamation.

2.1.1.1 Site Preparation, Infrastructure Enhancement, and Controls

<u>Storm Water Management System</u>

Storm water management controls are regulated under the Utah Pollutant Discharge Elimination System General Permit for storm water discharges from construction activities. Under these regulations, the State of Utah requires development of a storm water pollution prevention plan using good engineering practices before construction can begin. The existing plan would be modified to include descriptions of additional control measures that would be implemented. A storm water management system would be implemented to prevent water, sediments, soils, and materials from the site, any of which may be contaminated, from reaching Moab Wash and the Colorado River during the construction period. The system, which would comply with all applicable federal and state regulatory requirements, would be designed to control a reference 25-year storm event throughout the construction period and would include new or improved berms, drainage ditches and basins, hay bales, sediment traps, and silt fence fabric.

The existing Moab Wash would be rechanneled to run through the former millsite area (see Figure 2–3). Rechanneling would begin before completion of the disposal cell. The reconfigured channel would discharge into the river upstream near the approximate location of the pre-operations discharge point. The channel would be designed to carry runoff that has the approximate magnitude of a 200-year flood. Flood protection along the base of the pile would protect it from more significant floods. Material excavated during construction of the reconfigured channel would be used as either cover material for the pile or backfill for other areas of the site. Any material identified as contaminated would be placed on the tailings pile before the cover was installed. DOE would also perform flood analyses at Courthouse Wash to determine the best alignment and design requirements (see Figure 2–3).

Radiological Controls

The following radiological controls would be implemented to minimize the potential for personnel contamination or the spread of radioactive material.

Barriers

Radiation barriers would consist of signs and a system of steel “T” posts supporting standard yellow/magenta ropes to delineate radiation control areas. This action is consistent with DOE radiation safety requirements.

Personnel Screening and Decontamination

Personnel entering the site would be required to sign daily site access logs. Access to contamination areas would be controlled through a modular trailer that would be located at the site entrance (identified as the access area on Figure 2–3). A second modular trailer would be dedicated to laundering contaminated clothing. Contaminated wastewater from the laundry facility would be collected in lined ponds or sumps and eliminated using evaporation techniques, used for dust control applications during construction, or reused in equipment decontamination operations. Any excess would be distributed across the tailings surface before final covering was complete. Screening and decontamination would be performed according to appropriate DOE standards and procedures.

Vehicle and Equipment Screening and Decontamination

A vehicle and equipment decontamination facility with one bay would be constructed and located approximately as shown in Figure 2–3. Additional bays would be constructed if needed. The facility would be used to screen vehicles entering and leaving contamination areas on the site and to decontaminate any contaminated vehicles before they were released to leave the site. Similar decontamination stations used at other UMTRCA sites have used approximately 1,500 gallons of water per day. Drainage from decontamination spray-down operations would be directed to floor drains leading to a concrete sediment trap. Water would be decanted from the sediment trap into a double-lined recycle pond approximately 50 by 50 by 5 ft. Pumps installed in the recycle pond would provide recycled water to the spray hoses at the concrete pad. As needed, water to replace losses due to evaporation or overspray would be either piped below ground approximately 450 ft from the existing pump station water storage ponds (Figure 2–3) or supplied from water trucks. As construction activities involving contaminated materials decreased and as decontamination operations decreased, remaining or excess contaminated water not lost to evaporation would be sent to the tailings placement operations for use in dust control.

<u>Dust Control</u>

Windblown tailings and other contaminated material could create fugitive dust emissions. A dust control system would be implemented following provisions in the *Fugitive Dust Control Plan for the Moab, Utah, UMTRA Project Site* (DOE 2002a), which complies with State of Utah requirements specified in the *Utah Administrative Code* titled "Emission Standards: Fugitive Emissions and Fugitive Dust" (UAC 2000). Water for compaction and dust control would be drawn from the Colorado River. Dust suppressants such as calcium chloride, which would be stored in tanks, could also be used. Water would be stored in tanks or in the existing water storage ponds and applied only as needed, using the most economical and efficient delivery method.

<u>Water Pumping Station Enhancements</u>

Currently, nonpotable water from the Colorado River is pumped from an intake structure (pump house) to two connected, unlined water storage ponds located on the northeastern portion of the Moab site (Figure 2–3). This water is allocated under water rights held by DOE, which authorize 3 cubic feet per second (cfs) consumptive use and 3 cfs nonconsumptive use. Water from the pumping station would be used for all nonpotable water needs at the site. The water intake structure would be screened to ensure protection of aquatic species. In addition, the existing pumping station, piping, and storage ponds would require repairs and upgrades to supply the water demand during construction. Repairs required would include piping and pipe support structures, storage pond dredging, and general maintenance.

<u>Temporary Field Offices</u>

Temporary field offices would be installed to provide workspace, parking, and amenities for construction, management, or other personnel working on the site but not directly involved with field activities. The temporary field offices and other erected or emplaced facilities or structures would be painted a color similar to the background soils or vegetation to reduce visual impacts to travelers on US-191 and SR-279. The area, which would be located near existing trailers, would be graded and surfaced with a gravel base. The offices would be mobile trailers and would require setup and installation of electric utility service. The offices' sanitary sewer lines would be connected directly into a new holding tank system that would be pumped regularly by a local septic tank pumping vendor.

Vehicle Maintenance Area

The existing mill building would be converted into a vehicle maintenance area for on-site equipment. This conversion would require minor upgrades and maintenance to the building such as electrical service improvements and roofing upgrades. Spill containment areas for storage of engine oils, hydraulic fluids, and other hazardous materials associated with equipment maintenance would be constructed in the maintenance area.

Borrow Material Storage Area

Borrow materials obtained from off-site locations for use as tailings cover construction materials or clean backfill are discussed in Section 2.1.3. A borrow material storage area would be constructed for temporary storage of borrow materials. The area would occupy approximately 5 acres and would be located on top of clean (uncontaminated) soil (Figure 2–5) in an area already remediated. Off-site dump trucks delivering borrow materials to the site would dump them in the clean area and never enter the contamination zone.

Fuel Storage Area

A fuel storage and refueling area would be located within the contamination boundary to service on-site vehicles (Figure 2–5). The area would store from 5,000 to 20,000 gallons each of gasoline and diesel fuel. The area would include approved emergency containment berms around the tanks to contain spills, leaks, or ruptures and to provide adequate protection from precipitation and floodwaters resulting from a 25-year storm event as a minimum. A central delivery point for local vendors to resupply the storage tanks would be used to transfer the delivered fuel over or through contamination boundaries. Appropriate radiological and safety control practices and procedures would be followed.

Night Lighting

Grand County public land policy provides that if projects on public lands require night lighting, such lighting should be shielded and otherwise designed to prevent light pollution. DOE believes that some night lighting would be required as an occupational safety measure. However, the extent and duration of required night lighting would depend largely on the final work shift schedules that are used and the season of the year. If work activities continued after dark, night lighting would be a standard occupational safety measure. If and when required, mobile lighting would be moved from place to place as needs and work progress dictated. Either gasoline- or diesel-powered mobile lighting would be used and would have a minimum power of 500 watts. All night lighting would be shielded to reduce night sky glare that could be visible from Arches National Park.

2.1.1.2 Contaminated Material Remediation Operations

Contaminated Soil, Vegetation, and Debris

The contaminated surface areas of the site would be excavated using backhoes and bulldozers to a depth where the verified concentration of radium-226 in land averaged over any area of 1,076 square feet (ft^2) that does not exceed the background level by more than 5 picocuries per gram (pCi/g) averaged over the first 6-inch-thick layers of soil below the surface and 15 pCi/g averaged over 6-inch-thick layers of soil more than 6 inches below the surface (40 CFR 192.12), except where the provision for the application of supplemental standards under 40 CFR 192.21 apply. Excavated areas would be cleared and grubbed prior to removal of contaminated soils, and grubbed material would be hauled with contaminated soils.

> **Supplemental Standards and Surface Contamination**
> Remedial action will generally not be necessary when (1) residual radioactive materials (RRM) occur in locations where remedial actions would pose a clear and present risk of injury to workers or the public, (2) remediation would produce health and environmental harm that is clearly excessive compared to the health or environmental benefits, or (3) the costs of remedial action are unreasonably high relative to the long-term benefits. This includes instances where site-specific factors limit the RRM hazards and locations from which they are difficult to remove or where only minor quantities of RRM are involved (40 CFR 192.21).

An estimated 234,000 tons of contaminated site materials would be excavated from the site, loaded into dump trucks, hauled to the top of the tailings pile, and deposited on top of the center of the pile above the slimes (very fine grained tailings fraction). The weight of contaminated soils and debris placed on the tailings is called “surcharge.” Placing surcharge material on the slimes to accelerate settling is called “preconsolidation loading,” and the process of settling that ensues is called “consolidation.” DOE estimates that the consolidation loading process may require 3 to 5 years before the pile would settle sufficiently to allow final cover emplacement. To prevent cover cracking due to pile settling, final cover placement would not begin until 90 percent of the predicted consolidation settlement was complete.

Certain areas of the site are covered with vegetation, notably the tamarisk areas illustrated in Figure 2–3 and Figure 2–5. The tamarisk and materials from clearing and grubbing would be felled and chipped or crushed prior to being hauled to and spread over the disposal cell. Miscellaneous materials, including debris from the existing mill facilities, would be deposited in an area adjacent to the pile’s southeastern edges and covered with contaminated soil. This area would ultimately be stabilized under the final tailings cover.

> **Settling,** or pile consolidation, is a short-term engineering phenomenon that could affect the stability of the pile, especially the cap. It refers to the gradual compacting and lowering of the height of a tailings pile. It is caused by the weight of the pile squeezing liquids from slimes downward and out of the pile. The addition of new material or surcharge to the top of the pile results in added weight and accelerates the settling process.
>
> It is important that settling be essentially complete (90 percent consolidation) before the final cap is put on a tailings pile; otherwise, local or differential settling could cause the cap to bow, buckle, or crack. This could result in failure of the cap, water intrusion into the interior of the disposal cell, and an increased chance for contaminants to mobilize and migrate out of the disposal cell. Under the on-site disposal alternative, DOE estimates that after surcharge loading was complete, it would take 3 to 5 years for the pile to settle sufficiently to allow final cover emplacement.

Demolition and Disposal of Existing Mill Facilities

After DOE consulted with the State Historic Preservation Officer and agreed on mitigation measures, some or all of the remaining mill structures and features, shown on Figure 2–5, would be demolished due to varying levels of residual contamination found within the structures. The primary mill features remaining include the Uranium Reduction Company general office/warehouse/machine shop, pump house and pipeline, several sheds, scale house, and railcar loading structure.

The resulting debris would be sized, loaded onto dump trucks, and hauled to and deposited in the disposal cell. The 680 ft of chain link fence would also be taken down and disposed of at the disposal cell as potentially contaminated debris.

2.1.1.3 Disposal Cell Recontouring, Stabilization, and Capping

Figure 2–6 is a conceptual cross-section of the final condition of the disposal cell. The figure also illustrates the types and approximate dimensions of the materials that would be placed on the sides and top of the pile to contain radon emissions and stabilize the cell. This is a conceptual design and diagram only. The conceptual design is strictly intended to establish a reasonable basis for evaluating environmental impacts between the alternatives associated with this component of site remediation and reclamation. This assumed design is not intended to commit DOE to any specific cover design. A detailed design would be developed in the RAP following the ROD. Should the final design differ substantially from the design considered here, DOE would assess the significance of these changes as they relate to the decision-making process and the requirements of NEPA.

Section 2.2.5.2 discusses the White Mesa Mill disposal cell, for which a different cover design is addressed. The design for the White Mesa Mill site disposal cell cover is different from the design described for the other disposal alternatives because it is based on an unsolicited proposal submitted to DOE and reflects a design more typical of UMTRCA Title II uranium mill tailings reclamation. A brief description of the White Mesa Mill cover design is also included in Appendix B. By including both design approaches, DOE has attempted to support decision-making by presenting a range of potential cover design approaches and a sense of the associated impacts related to the cover component selected for the final remedy.

After all contaminated materials were relocated to the top of the tailings pile and the consolidation process was under way, final side slope grading and recontouring would begin. The side slopes would be recontoured to a 3:1 horizontal:vertical (3H:1V) slope, a downward angle of approximately 19 degrees. Final side slope cover construction would begin after the slopes were graded.

Final cover construction would start with placement of the compacted soil layer that would form the radon barrier. Clayey soil borrow material (see Section 2.1.3.1) would be transported to the site in tandem trailers, conveyed by on-site vehicles to the base of the pile, then pushed up the recontoured slopes with a dozer. These materials would be moisture-conditioned and compacted to achieve the appropriate density specifications and quality assurance/quality control criteria.

Placement of the capillary break sand/gravels and the water storage soil layer above the radon barrier would follow, using a similar procedure. Erosion control stone riprap would be the final layer placed on the side slopes. After the required thickness of riprap was placed on the side slopes, interstitial voids in the riprap would be loosely filled with soils and seeded with native or adapted plant species. A riprap-filled toe apron would provide erosion protection at the toe and prevent destabilizing of the impoundment.

Construction of the remainder of the top slope cover would be similar to that of the side slope with the exception of the erosion protection layer. The top slope would use a soil/rock admixture for initial erosion protection. Rocks would be spread on the surface of water-balance soils and mixed into it. The rock admixture would provide additional erosion protection and cover vegetation growth medium.

More detailed descriptions and technical discussions of the disposal cell cover design concept and borrow materials are provided in Appendix B, "Assumed Disposal Cell Cover Conceptual Design and Construction," and Section 2.1.3.1.

2.1.1.4 Site Reclamation

When the disposal cell construction is completed, recontouring and revegetating, where needed to limit erosion, would be performed to reclaim the area outside the cell. Native plant species would be used to revegetate the site. Clean reclamation soil (320,000 yd^3) would be applied to an average depth of 6 inches over the area outside the cell to meet the radium-226 subsurface soil standard of 15 pCi/g above background averaged over a 1,076-ft^2 area. The standard would apply regardless of future land use decisions.

A buried riprap diversion wall would also be constructed along the Colorado River as proposed by Atlas Corporation and approved by NRC (Figure 2–3). Although DOE's assessment of river migration (DOE 2003a) suggests that this diversion wall would not be required, it would provide additional assurance that the design life of the cell could be met. The length and design of the wall would be addressed at the conceptual design stage.

2.1.2 Characterization and Remediation of Vicinity Properties

Because of the range of variables and uncertainty associated with Moab site vicinity properties (e.g., their exact number, size, location, and extent of contamination), the specific actions that DOE proposes to take at each property would necessarily vary. The following sections provide a general overview of the activities that DOE would undertake to survey, characterize, and remediate Moab site vicinity properties. Data obtained from characterization of the Moab site suggest that vicinity properties surrounding the site will contain contamination requiring remediation. These properties include portions of state highway and railroad rights-of-way, BLM property, and Arches National Park.

Properties in the vicinity of the Moab millsite (Figure 2–7) that can be confirmed to be contaminated with residual radioactive materials (RRM) would be eligible for inclusion in the vicinity property program. For the purposes of this program, RRM contamination is intended to be restricted to materials directly related to the milling process and is not intended to include uranium or vanadium ores or other naturally occurring radioactive materials not directly related to the milling process.

Conceptually, ores or other naturally occurring radioactive materials not directly related to the milling process would not be eligible for remediation under this program unless it could be demonstrated that these materials are inextricably mixed with RRM.

Unless specifically excluded under EPA's supplemental standards (40 CFR 192.21), contaminated materials on vicinity properties in which radium-226 concentrations averaged over any area of 1,076 ft^2 exceed the background level by more than 5 pCi/g averaged over the first 6 inches of soil below the surface and 15 pCi/g averaged over 6-inch-thick layers of soil more than 6 inches below the surface (40 CFR 192.12) would be hauled by truck from the vicinity property to the Moab site. These materials would be unloaded in a vicinity property material stockpile area (see Figure 2–5) pending final placement in the disposal cell. DOE estimates that approximately 2,940 trips using 10-yd^3 dump trucks would be required, each averaging approximately 4 miles one way to the Moab site. The trips would generally involve using residential streets to access US-191 and established haul routes to the Moab site. If necessary, trucks would be decontaminated at both the vicinity property and at the millsite. An equivalent volume of fill material and truck traffic from the LeGrand Johnson borrow area (located in Spanish Valley) would be required.

A detailed outline of the remedial action process is provided in the *Vicinity Properties Management and Implementation Manual* (VPMIM) (DOE 1988). DOE intends to work with NRC to update the procedures in the VPMIM to reflect lessons learned from the Grand Junction, Colorado, and Monticello, Utah, vicinity property programs and amendments to UMTRCA. An example of lessons learned would be establishing the protocol for evaluating and mitigating elevated radon levels in structures after completion of remedial action. In the past, NRC did not require its approval of individual radiological and engineering assessments (REAs) as long as the VPMIM was followed, unless they involved supplemental standards. DOE intends to continue this practice.

2.1.2.1 Survey and Characterization

DOE would identify properties to be surveyed and radiologically characterized to determine their eligibility for remediation. By definition, DOE would designate the 130 properties identified in EPA's 1971 survey (EPA 1971) as vicinity properties, provided contamination on a property meets the regulatory definition of RRM. The 1971 survey used a mobile gamma scan procedure. A field team investigated gamma anomalies on a property after the property owner granted access. The survey team tried to identify the source of the contamination and whether it was from tailings, ore, or other radioactive materials.

For the purpose of identifying the scope of the EIS, a specified area is proposed for DOE to perform additional gamma radiation surveys (see Figure 2–7). DOE proposes to limit surveys to the 130 designated properties and to properties within the area shown in Figure 2–7 whose owners request a survey. DOE would advertise through the newspaper and other media that a vicinity property program was being conducted and that owners should contact DOE for gamma surveys. However, DOE would also consider requests from other individuals or entities if they could demonstrate that contaminated material might be on their property and that it might be tied to Moab millsite activities. Prior to gamma survey work, DOE would obtain the consent of the property owner for access as provided under UMTRCA.

Characterizations would include gamma surveys, soil samples, and radon daughter concentration measurements. A summary of the characterization data and remediation design would be documented in an REA. Results of these characterization studies would be used to determine which properties require mitigation and remediation to meet the standards of 40 CFR 192.

2.1.2.2 Remediation

After the characterization process, remediation would involve execution of a remedial action agreement (RAA), contracting, health and safety planning, excavation, transportation, restoration, preparation of a completion report, certification, and document transfer/archiving. DOE would obtain an RAA from each property owner whose property required remedial action. Each RAA would describe a plan for remedial action based on the selected option in the final REA. It also would provide assurance that the property would be restored to its pre-remedial action condition to the extent practicable, a release of liability to DOE from the owner, and if required, provisions for dislocation and temporary relocation and reimbursement costs for the property owner or tenant. An RAA would also provide that DOE would obtain title to the RRM removed from the property.

From experience with Monticello and Grand Junction vicinity properties, DOE assumes that up to 98 of the currently identified 130 Moab vicinity properties may require remediation, and that the average Moab vicinity property remediation would involve 300 yd^3 of contaminated material and would disturb 2,500 ft^2 of surface area. Using the average remediation volume and an estimate that 98 properties would be included, DOE estimates that approximately 29,400 yd^3 (about 39,700 tons) of contaminated material would be remediated. Should additional properties in the proposed inclusion survey area be identified, it is assumed that the effort and volumes would increase proportionally.

Alternatives for remedial action would depend on the number of properties where contaminant concentrations exceed EPA standards, the complexity of the properties, the levels of congressional funding, and the length of time the disposal cell remained open. DOE estimates that remedial actions would be conducted at a rate of 33 to 98 properties per year, or for a period of about 1 to 3 years.

At 300 yd^3 per property, 30 trips per property averaging 4 miles to the Moab site would be required. Trucks would be tarped and decontaminated before leaving a property. A typical route would be one-half mile along residential streets and an average 3.5-mile trip through town on US-191. The equivalent number of trips for backfill material (sand, loam, silty loam) would also be required. Dust suppression would normally not be required due to the small size of the excavations; however, a water truck would be used as needed to control dust and supply compaction water.

DOE estimates that a typical vicinity property remediation would take 4 to 6 weeks to remove tailings, replace with backfill, and restore landscaping. A standard workweek of 10 hours per day, 4 to 5 days per week, would be used. Longer days could be used occasionally to accommodate a special need, such as a concrete pour. If remediation of all 98 vicinity properties were completed in 1 year (250 days), it could require up to 24 daily round trips on US-191 transporting vicinity property material to the Moab site and backfill material to the remediated properties.

After remediation was complete, DOE would develop the completion report documenting that the property was remediated to EPA standards in 40 CFR 192 and issue a certification to the owner if the standards were met.

2.1.2.3 Residual Radioactive Materials Combined with Other Hazardous Components

RRM combined with other hazardous components could be present on some vicinity properties. Other hazardous components on vicinity properties that are combined with RRM would not usually be considered related to the uranium milling process; therefore, these other hazardous components would not be considered RRM. Consequently, the non-RRM hazardous component of this combined waste could be subject to regulation by the Resource Conservation and Recovery Act (RCRA) or the Toxic Substances Control Act (TSCA). This type of combined vicinity property waste was historically referred to as “commingled waste” under the UMTRA Project. For the purpose of establishing a planning basis for waste management analysis in this EIS, DOE has assumed that all commingled waste would ultimately be approved for management and disposal as RRM and would be disposed of in the selected disposal cell. However, if it were determined at a later date that RCRA or TSCA provisions apply to the non-RRM hazardous component of commingled waste, such waste would not be transported directly to the Moab site. DOE would evaluate various potential disposal paths, including treating the commingled waste to render the hazardous component nonhazardous, disposing of the commingled waste in a facility licensed for radioactive mixed waste, or leaving the commingled waste on the vicinity property by implementing supplemental standards in accordance with 40 CFR 192.21.

It could take several additional weeks or months to characterize and remediate a property with commingled waste. The additional time could be required because of the need for DOE decisions regarding the most feasible, cost-effective disposal path; laboratory analyses for characterizing the commingled waste; or treatment of the commingled waste.

DOE does not expect significant quantities of commingled waste on the Moab vicinity properties. A waste management plan for characterization and remediation of commingled waste would be prepared and implemented before remediation of the vicinity properties.

2.1.2.4 Applicable Regulations

DOE anticipates that a U.S. Department of Transportation (DOT) exemption, similar to that obtained for the DOE UMTRA and Monticello Projects, would allow exemption from certain regulations pertaining to the hauling of uranium and thorium mill tailings, soils, and other materials contaminated with low levels of RRM from vicinity properties. This exemption is described in further detail in Section 2.2.4.1.

Most indoor remedial action would require local building permits. These and other local permits would be obtained as necessary. Larger remediations may require storm water control permits, which would typically result in some level of management. Any anticipated disturbance of wetlands or floodplains would follow floodplain and wetland environmental review requirements in 10 CFR 1022, applicable state stream bank alteration permit requirements, or U.S. Army Corps of Engineers 404 permit requirements. Most vicinity properties do not involve discharges of water because excavations do not generally intersect the water table.

2.1.3 Construction and Activities at Borrow Areas

Five different borrow materials obtained from off-site locations would be used to construct the disposal cell cover and to reclaim site surface areas after completion of remediation: cover (moisture storage) soils, radon/infiltration barrier soils, capillary break in the form of sand and gravel, riprap, and reclamation soils. These materials would be excavated from several potential borrow areas and transported in transport trucks to the Moab site, where they would first be stockpiled in an uncontaminated borrow material staging area, then used for cover construction or surface reclamation.

Table 2–1 lists the borrow materials and the potential source locations where they could be obtained for both the off-site and on-site disposal alternatives; the source locations are based on a review of area soil maps and commercial quarries. Figure 2–8 illustrates the potential source locations of borrow materials. The Tenmile, Courthouse Syncline, and Blue Hills Road cover soil borrow areas are near, but not on, the Klondike Flats site, which is discussed in Section 2.2.

Table 2–1. Borrow Materials and Potential Source Locations

Borrow Material	Potential Source Location
Cover Soils	Floy Wash borrow area Crescent Junction borrow area Tenmile borrow area (near Klondike Flats site) Courthouse Syncline borrow area (near Klondike Flats site) Blue Hills Road borrow area (near Klondike Flats site) White Mesa Mill borrow area
Radon/Infiltration Barrier Soils	Crescent Junction borrow area Klondike Flats site
Sand and Gravel	LeGrand Johnson borrow area
Riprap	Papoose Quarry borrow area Blanding borrow area[a]
Reclamation Soils	Floy Wash borrow area

[a]Source for White Mesa Mill only.

Section 2.1.3.1 describes standards and requirements that would apply to the borrow materials, and Section 2.1.3.2 describes the borrow material excavation procedures that would be used, including transportation routing alternatives, distances, durations, and logistics to transport the borrow materials to the Moab site.

2.1.3.1 Borrow Material Standards and Requirements

Riprap

Riprap is an outer layer of stone that would serve as an armor to protect the inner layers of water storage soil, capillary break sand and gravel, and radon barrier soil from the erosive effects of wind, precipitation, and flooding. The riprap would meet the NRC durability requirements in NUREG-1623, *Design of Erosion Protection for Long-Term Stabilization* (NRC 2002). Appendix D of NUREG-1623 notes that the principal objective in determining the riprap durability requirements for stabilized side slopes of embankments is to provide a material that meets long-term design requirements. Because the most disruptive event for these designs is likely to be gully erosion, it is important to provide a rock layer that would minimize the potential for gully erosion, which, once started, may worsen and continue unchecked. The Papoose Quarry borrow area listed in Table 2–1 has been sampled and tested by DOE for use at the Monticello disposal cell to verify that the material would meet the durability requirements of NUREG-1623. The nominal diameter of the riprap used to stabilize the disposal cell would be no greater than 12 inches.

Cover Soils

The primary function of the borrow soils used to construct the disposal cell's water storage soil layer would be to minimize infiltration of water to the underlying materials. The water absorption characteristics of these soils would result in water being retained in the soils when plants are dormant. During the growing season, vegetation in the overlying soil/rock admixture or riprap layers would extract stored water and return it to the atmosphere. Consequently, the amount of water that permeates downward would be minimized.

Types of cover soils best suited to this purpose have been selected on the basis of their water-holding and rooting characteristics. Three U.S. Department of Agriculture soil textures—loams, silt loams, and clay loams—would provide the best storage capacities (Stormont and Morris 1998). Potential soil borrow areas have been selected on the basis of availability of these soil types and on logistics and impacts considerations. These soil types would also be used as reclamation soils in all areas of land disturbances.

Sand and Gravel

The primary function of the coarse sand and gravel (capillary break) layer in the disposal cell cover would be to minimize downward movement of water under saturated conditions. The coarse sand and gravel layer would be placed under the finer-grained water storage layer and above the radon barrier soils. The capillary layer would limit downward water movement and increase the water storage capacity of the water storage layer. High tension in the small pores of the fine-grained water storage layer would impede movement of water into the larger pores of the underlying sand and gravel.

Other sand and gravel would be mixed with soil to form the disposal cell's top layer, which would control erosion and provide a matrix for plant growth. The material would meet the same NRC NUREG-1623 durability standards cited for riprap.

Radon/Infiltration Barrier

The radon barrier is a compacted soil layer of clay that would be placed directly above the tailings and contaminated materials to control radon release and limit water infiltration. Clayey soils would be derived from weathered Mancos Shale in the Klondike Flats and Crescent Junction borrow areas. The thickness of the radon barrier would be based on calculations of radon flux using the computer program RADON (NRC 1989). RADON would be applied in an iterative procedure to determine the compacted soil layer thickness that would prevent the annual average radon flux from exceeding 20 picocuries per square meter per second (pCi/m^2-s).

Moab Site Reclamation Soil

Clean, fine-grained, silty- to sandy-loam reclamation soil assumed to come from the Floy Wash borrow area would be used to backfill the entire Moab site to an average depth of 6 inches and to backfill pond areas. The reclamation soil would be used to meet the radium-226 subsurface standard of 15 pCi/g above background averaged over a 1,076-ft^2 area, which would apply regardless of any future land use.

2.1.3.2 Borrow Material Excavation and Transport Operations

Cover Soil and Radon Barrier Soil Areas

The procedures used to excavate and transport cover soils and radon barrier soils would be similar regardless of the borrow area selected. The excavation would require dozers to scrape and stockpile the soil, front-end loaders to load trucks from the stockpile, and tandem trucks to transport the material.

The general construction sequence at soil borrow areas would be as follows:

1. Access road upgrades would be required for three of the soil borrow areas: Tenmile (4.5 miles, approximately 9 days construction time), Courthouse Syncline (4.5 miles, approximately 9 days construction time), and Klondike Flats (2.0 miles, approximately 4 days construction time). The duration of road upgrade construction would depend on the extent of the required upgrade and roadbase delivery schedules. DOE estimates that 4 inches of roadbase would be required over the length of the access road and that 0.5 mile of road would be upgraded per day. For the purpose of this EIS, it has been assumed that the roadbase would be delivered from the LeGrand Johnson borrow area located in Spanish Valley.
2. A temporary office trailer and portable toilet would be located at the borrow area. DOE does not expect that utility hookups would be required. Water trucks would be used for dust suppression and would obtain the water from the Colorado River via the Moab site water storage ponds for the Moab, Klondike Flats, and Crescent Junction sites or from deep wells or Recapture Reservoir at White Mesa.
3. Approximately 1 ft of topsoil would be stripped along with clearing and grubbing debris from approximately one-third of the total area that would be disturbed, and the topsoil would be reserved in piles no more than 3 ft high. This topsoil would later be used to reclaim the borrow area.
4. Excavation and removal of borrow materials would be continuous over the course of approximately 1 to 2 years. Dozers would scrape the borrow soil into stockpiles that would subsequently be loaded onto trucks with front-end loaders. DOE estimates that local truckers would transport the materials and that a fleet of approximately five trucks would be used.
5. At the Moab site, the borrow soils would first be stockpiled in an uncontaminated area. As construction of the disposal cell cover proceeded and schedule dictated, soils would be taken from the uncontaminated stockpile area and deposited at the base of the disposal cell for emplacement or for interim storage. This process of excavation and transportation to the Moab site would continue until the required volume of borrow soil had been removed.
6. The disturbed borrow area would be reclaimed with the set-aside topsoil and reseeded with native vegetation.

Commercial Quarries

Riprap and sand and gravel excavation and hauling operations at commercial quarries would be governed by the quarry operator's standard operating procedures. Riprap for the on-site disposal alternative would be obtained from the Papoose Quarry borrow area in Lisbon Valley. It has been assumed that sand, gravel, and road base would be obtained from the LeGrand Johnson borrow area (Gravel Pit) in Spanish Valley. The stockpiling procedures at the Moab site for riprap, sand, and gravel would be similar to those for borrow soils.

Transport Truck Traffic Density

Assuming implementation of the 1-year top slope cover construction option, borrow material transportation would be ongoing for approximately 3.75 years (1,313 days) (Figure 2–4). DOE estimates that the transport of borrow materials would require 43 daily round-trips (shipments) from borrow areas to the Moab site. Table 2–2 shows the estimated daily round-trips, total volume, and total shipments for each of the five types of borrow material. Table 2–3 illustrates the highway segments that could be used to transport them to the Moab site. If the less aggressive 2-year top slope cover construction schedule were implemented, borrow material transport would be ongoing for approximately 4.75 years, and the daily trips shown in Table 2–2 and Table 2–3 would be reduced by approximately 25 percent. As shown in Table 2–1, there are several optional borrow areas for obtaining cover soil. Table 2–3 assumes that all cover soils would come from the Floy Wash borrow area (as would all Moab site reclamation soil) . This option would generate the most traffic on public highways.

Table 2–2. Summary Logistics for Borrow Material Transportation

Borrow Material	Daily Round-Trips (1-year Top Slope Cover Construction Option)[a]	Total Volume (yd^3)	Total Shipments
Cover soils	19	826,000	25,030
Radon/infiltration barrier soils	9	365,000	11,200
Sand and gravel	3	119,300	4,200
Riprap	5	140,000	6,363
Site reclamation soils	7	320,000	9,670
Total	**43**	**1,770,300**	**56,463**

[a]Assumes one shift operating 12 hours a day, 7 days a week would require approximately 3.75 years to complete transportation of the borrow materials.

Table 2–3. Borrow Material Transportation Segments and Distances

Highway	Segment	Material	Distance	Daily Round-Trips (1-year Top-Slope Cover Construction Option)[a]
Interstate 70	Floy Wash to Crescent Junction exit	Floy Wash soils[b]	7 miles	26
U.S. Highway 191	Crescent Junction exit to Moab	Floy Wash soils[b]	28 miles	26
	Klondike Flats to Moab	Radon barrier soils	18 miles	9
		Segment Total	–	35
	La Sal Junction through Moab	Papoose Quarry riprap	22 miles	5
	Spanish Valley through Moab	LeGrand Johnson sand & gravel	6 miles	3
		Segment Total	–	10
Lisbon Valley Road and Utah Route 46	Lisbon Valley to La Sal Junction	Papoose Quarry riprap	6 miles	5

[a]Assumes one shift operating 12 hours a day, 7 days a week would require approximately 3.75 years to complete transportation of the borrow materials.
[b]Includes cover soils and site reclamation soils.

2.1.4 Monitoring and Maintenance

DOE would have responsibility for long-term monitoring of the Moab site after completion of remediation and reclamation activities. Monitoring and maintenance of the Moab site after completion of site remediation would be in accordance with the site's Long-Term Surveillance and Maintenance Plan. The site is a Title I UMTRCA site and falls under NRC's general license pursuant to 10 CFR 40.27. For the license to become effective, NRC must accept the site's Long-Term Surveillance and Maintenance Plan.

As discussed in Section 1.4.5, release of portions of the site for future uses would depend on the success of site remediation. DOE's ultimate goal would be to remediate to unrestricted surface use standards. However, DOE would defer its decisions on the release and future use of the Moab site pending an evaluation of the success of surface and ground water remediation.

Monitoring and inspections would pay particular attention to identifying any lateral stream cutting or migration of the Colorado River. Areas around the buried riprap diversion wall and along the toe of the impoundment would be inspected for erosion. The buried riprap diversion wall would be constructed from relatively large riprap (12- to 36-inch diameter) that would fall into, and fill, voids caused by soil erosion. However, if an erosion problem were observed, the eroded area would be remedied by refilling the area.

2.1.5 Resource Requirements

The following sections describe the major resource requirements for the on-site disposal alternative. Where appropriate, resource availability is also discussed.

2.1.5.1 Labor

The on-site disposal alternative would require work to be performed at the Moab site, including infrastructure requirements and all the activities required to physically shape the existing tailings pile, construct the cover, and reclaim the site. It would also require work at the vicinity properties and borrow areas. Table 2–4 shows the annual average labor requirements based on a 12-hour work shift option working 7 days per week (4 to 5 days per week for vicinity properties), 350 days per year.

Table 2–4. Average Annual Labor Requirements—On-Site Disposal Alternative

Worker Category	Activity Location			Total
	Moab Site	Vicinity Properties	Borrow Areas[a]	
Equipment operators	18	6	1	25
Site support	13	4	4	21
Truck drivers	4	3	41	48
General labor	12	10	4	26
Total workforce	**47**	**23**	**50**	**120**

[a]Borrow operations would require minimal equipment operators to accommodate haul trucks because of the length and duration of travel between the source and point of use.

2.1.5.2 Equipment

The on-site disposal alternative would require equipment to be operating at the Moab site, vicinity properties, and borrow areas, and truck transportation between these areas. Table 2–5 represents the annual average equipment requirements based on a 12-hour work shift option working 7 days per week (4 to 5 days per week for vicinity properties), 350 days per year.

Table 2–5. Average Annual Equipment Requirements—On-Site Disposal Alternative

Equipment Type	Activity Location			Total
	Moab Site	Vicinity Property	Borrow Area	
Tractor	1	–	–	1
Backhoe	2	1	–	3
Grader	3	–	–	3
Trackhoe	–	–	–	–
Front-end loader	1	1	1	3
Water truck	2	1	1	4
21 yd^3 scrapers	2	–	–	2
Dozer	2	–	–	2
Sheepfoot compactor	1	–	–	1
Smooth drum roller	1	–	–	1
Pickup truck	2	2	3	7
End dump truck	1	1	–	2
Skidsteer	–	2	–	2
Tandem truck	–	–	28	28
Total	**18**	**8**	**33**	**59**

2.1.5.3 Land Disturbance

<u>Moab Site and Vicinity Properties</u>

The on-site disposal alternative would disturb approximately 439 acres at the Moab site and 6 acres at vicinity properties.

<u>Borrow Areas</u>

Estimates of required volumes of borrow material are shown in Table 2–2. The range of estimated areas of land disturbance at potential borrow areas is shown in Table 2–6. This table shows all potential borrow area disturbances; however, not all these areas would be used. Final decisions would be based on additional surveys. For the purpose of assessing impacts, DOE estimates that the range of disturbed borrow area land for this alternative would be 140 to 550 acres, depending on the final selection of the borrow area source for cover and reclamation soils and on the final depth to which these soils could be excavated. This estimate excludes disturbances to privately operated commercial quarries that would provide sand/gravel and riprap.

2.1.5.4 Fuel

DOE estimates that the on-site disposal alternative would require an annual average of 820,000 to 830,000 gallons of diesel fuel, depending on the top slope cover schedule implemented, and that total fuel consumption for the project would range from 4 million to 5 million gallons.

Table 2–6. Estimated Area of Disturbed Land at Borrow Areas

Borrow Material/Area	Estimated Area of Disturbance (excavated acres or quarried volumes)	Estimated Available Area/Volume
Cover and Reclamation Soils		
Floy Wash	178–380 acres	1,035 acres
Crescent Junction	70–100 acres	4,925 acres
Tenmile	115–250 acres	1,480 acres
Courthouse Syncline	70–155 acres	4,925 acres
Blue Hills Road	70–185 acres	900 acres
Radon Barrier		
Klondike Flats	100–170 acres	10,000 acres
Crescent Junction	70–100 acres	4,925 acres
Sand and Gravel		
LeGrand Johnson	43,000–140,000 yd^3	13,000,000 yd^3
Riprap		
Papoose Quarry	185,000–257,000 yd^3	3,500,000 yd^3
Blanding	8–10 acres[a]	1,355 acres
Soils and Clay		
White Mesa Mill site	63–83 acres	300,000–400,000 yd^3

[a]Assumes rock thickness of 12 ft at borrow area.

2.1.5.5 Water

Potable water would be required for drinking, washing, toilets, contaminated clothing laundering, and other uses and would be purchased from the City of Moab. Nonpotable or construction water would be required for dust control, earth compaction, equipment decontamination, and other uses and would be derived from DOE's Colorado River water rights. DOE estimates that the total potable water requirement for the on-site disposal alternative would be 4,200 gallons per day, or approximately 30 gallons per day per worker. DOE estimates that the average annual nonpotable water requirement would be 70 acre-feet, or a project total of approximately 490 acre-feet assuming a 7-year project duration.

2.1.5.6 Solid Waste Disposal

The on-site disposal alternative would generate approximately 1,040 yd^3 of uncontaminated solid waste per year. The solid waste would be disposed of in the Grand County landfill.

2.1.5.7 Sanitary Waste Disposal

DOE estimates that the on-site disposal alternative would result in the generation of approximately 10,000 gallons of sanitary waste per week, or approximately 1,430 gallons per day, assuming a 12-hour shift. Septic holding tanks connected to bathrooms in the trailers would be placed at the Moab site along with portable toilets used to provide sanitary waste service. Both the septic tanks and the portable toilets would be pumped out routinely and disposed of at the city of Moab sewage treatment plant.

2.1.5.8 Electric Power

DOE estimates that under the on-site disposal alternative, the existing electrical service at the Moab site would be required to support an estimated maximum demand of 600 kilovolt-amperes (kVA). The primary demands for this power would be:

- Conversion of the mill building to a vehicle/equipment maintenance shop.
- Field office trailers.
- Office and parking lot security lighting.
- River pump station.
- Decontamination water sprays and recycle pumps.

2.2 Off-Site Disposal Alternative

The off-site disposal alternative would entail excavating and relocating the entire Moab site tailings pile, other contaminated on-site material, and all contaminated material from vicinity properties to one of three alternative off-site disposal cells that would be constructed specifically as a permanent repository for these materials. The three proposed off-site disposal alternatives DOE is evaluating are Klondike Flats and Crescent Junction, which are north of the Moab site, and the White Mesa Mill site to the south. Figure 2–9 shows the Moab site and the three potential disposal sites. DOE is also evaluating three alternative modes of transportation to move the material to the off-site disposal cell: truck, rail, and slurry pipeline; however, as described further in Section 2.5.2, rail transport is not an option for the White Mesa Mill site. Contaminated material from vicinity properties would first be moved to the Moab site, then transported to the off-site disposal location. Contaminated ground water at the Moab site would also be remediated under the off-site disposal alternative as described in Section 2.3.

The major actions associated with implementing the off-site disposal alternative would be:

- Construction and operations at the Moab site (Section 2.2.1).
- Characterization and remediation of vicinity properties (Section 2.2.2).
- Construction and operations at the borrow areas (Section 2.2.3).
- Transportation of contaminated material from the Moab site to the off-site disposal location (Section 2.2.4).
- Construction and operations at the off-site disposal location (Section 2.2.5).
- Monitoring and maintenance of the off-site disposal cell (Section 2.2.6).
- Ground water remediation at the Moab site (Section 2.3).

Resource requirements for remediation activities are discussed in Section 2.2.7.